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PERFORMANCE OF LOCOMOTIVE ENGINES.

There can be no better evidence of the recent improvements in the construction of Locomotive Engines, than the narrow limits within which the maximum efforts of the engines of the best construction are confined. Hence there arises a keen contest for the superiority, and when the data of the performance are not complete, and they seldom, if ever are, it is no difficult matter for either party to show by the aid of apparently very exact calculations, that they have carried off the palm. The reports of the majority and minority of a committee appointed by the Western railroad Corporation, to attend the trial of the "America," built by Mr. William Norris, of Philadelphia, are striking illustrations of this fact. Our readers have had laid before them two statements containing the substance of the report of the majority of the committee (the report itself not being in our possession) and that of the minority.

Before proceeding to discuss these papers we beg leave to offer a few remarks upon the observations appended to one of these statements by George W. Whistler, Esq., Civ. Eng. W. railroad. The position taken by Mr. Whistler is this, that the *effective* power of any two engines is in direct proportion to the available weight for adhesion, or in other words, to the weight upon the driving wheels. This, we presume, no one will pretend to dispute, but we are not quite so willing to agree with the inference which we understand to be drawn, viz., that all engines being built upon nearly the same principles, and producing their effective power merely by the weight upon the drivers, there is no reason why we should attribute a *peculiar* power to engines of any particular construction. Now al-

though we are perfectly willing to admit the absurdity of supposing that there can be a peculiar power of adhesion or counter gravitation, yet we must confess that the experiments (admitting them to be correct) do prove a peculiar power of increasing the weight of the drivers in the Norris Engine. We are opposed to all mystification upon such subjects, and there is no doubt that wherever it has been attempted, discredit has been attached to statements really true. We have taken some little pains to inquire into the peculiar construction of several of the different engines in use, and feel satisfied that it is easy to account for the extraordinary power which certain engines have of producing a greater adhesion than the ordinary observation would lead us to expect, or even than the most careful weighing would indicate. It is no business of ours to publish what engine makers have to keep secret, although we are not indebted to them for the discovery. The thing is so evident that any one may notice it. We have said that we are opposed to mystification, and were there any necessity, we should feel no hesitation in discussing the matter very freely. Having labored against popular prejudice, to prove that American Locomotives were equal, if not superior in construction to those made abroad, it would be unfair to decry any one of the many well made patterns in use among us. We have no interest in any one of them, and are very glad to see them all do their best.

At the trial on the Western railroad the engines used were the "*America*," built by Mr. William Norris, of Philadelphia, and the "*Suffolk*," built at Lowell. The loads drawn over a grade of 66 feet to the mile, prove that they were both well built engines, and capable of answering the purpose of a heavy traffic. The effective power of these as estimated by the majority of the committee was ascertained by an experiment which we conceive to have been improper for that purpose, and that such was the fact we shall endeavor to prove from the experiments themselves.

The mode of connection in the tender of the *America* led the committee to suppose that when in action, an additional weight would be thrown upon the drivers. To verify this, the engine and tender were made fast, and the drivers were weighed under a full head of steam, the forward wheels were likewise weighed under the same circumstances. This operation was repeated upon the "Suffolk." The results are as follows:

America.

Weight on forward wheels, *without* steam,	11,590 lbs.
Do. do. do. *with* steam,	9,650
Difference,	— 1,940

Weight on driving wheels *without* steam,	18,620
Do. do. do. *with* steam,	20,010
Difference,	+ 1,390
A second weighing gave	
Weight on driving wheels *without* steam,	19,220
Do. do. do. *with* steam,	21,070
Difference,	+ 1,850
Total weight of engine,	29,241 lbs.

Suffolk.

Weight on driving wheels *without* steam,	16,075 lbs.
Do. do. do. *with* steam,	17,150
Difference,	+ 1,075
Weight on forward wheels *without* steam,	7,480
Do. do. do. *with* steam,	5,700
Difference,	— 1,780
Total weight of engine,	23,630

Of the difference between the first and second weighing of the *America*, it is remarked that notwithstanding the addition of the weight of the fireman and engineer, the discrepancy is too great, and as the second was made with great care, it would appear that the first was erroneous. Both weights, however, were used to obtain the mean.

With all due difference to the judgment of those who instituted this experiment, we cannot but consider it as inexact and totally devoid of reliance. The operation of weighing the drivers of a quiescent engine is liable to error unless carefully performed, but it appears to us next to impossible that any information can be obtained when the full head of steam is applied to a powerful engine. We have not heard a single opinion to the contrary from any one with whom we have conversed on this subject. Engineers, manufacturers and scientific men, having no interest in the question have with one voice pronounced the experiment improper.

In the first place the moment of taking the weight may have considerable influence, and this is admitted in one of the reports.

"The difference in these weights under the pressure of steam may be attributed to the different positions of the cranks at the time of weighing, since the effects would vary from a maximum to nothing, depending upon their position."

The difference in the America referred to, amounts to 1060 lbs.

Moreover the friction upon different portions of the wheels may differ considerably and vary the result, as the actual velocity at the time of taking the weight may be greater or less than the average velocity of the engine upon the road. In the second place, apart from all fluctuations during the continuance of the same engine upon the platform, the comparison between two engines can never be exact. Can it be as certain that the tangential point upon the platform is precisely the same?—and if it is not the same how can we estimate the difference of the friction at different points? a spot of oil or a slight irregularity in the point of support would materially vitiate the results. If in weighing the same engine a difference of 1,060 lbs. occurs, may not the comparison of engines of dissimilar size and construction, vary several thousand pounds? In this experiment the diameter of the drivers was not the same—another source of error. The tenders were chained to the track—and being of entirely different patterns, the circumstances were totally unlike in the two cases and undoubtedly produced a still greater departure from the truth.

If we had two simple and perfectly made machines, with polished wheels bearing upon a polished surface, weighing but a few ounces and both as nearly alike as the most skilful workman could make them, an experiment analogous to the one we are discussing might give results differing but a few grains. Instead of this we have not ounces but tons; engines of different size, weight and construction, the surfaces in contact purposely left unpolished, and in short every source of error carried out to the extreme case, and not one single mitigation to be found.

But it is by no means necessary to resort to theoretical considerations in order to prove the unsatisfactory nature of the experiment, the results actually obtained are sufficient to overthrow any deductions made from them. It will be seen that in both cases the increase of weight upon the drivers is less than the diminution of weight upon the forward wheels, or in other words that *the entire weight of both engines was diminished while under a full head of steam, the America losing* 550 *pounds and the Suffolk* 705 *pounds;* a result worthy of further consideration, as it still encourages "expectations that could never be realised without some special dispensation of the law of gravity." It cannot be said that these are trifling discrepancies, for the amount is in one case $\frac{550}{1300}$ and in the other $\frac{705}{1075}$ of the very effect which these experiments are intended to prove. If the palpable and evident error is from about one half to three-fourths, how much of the remainder is to be allowed for all other sources of inaccuracy?

A more striking proof of the great caution necessary in trusting to the most elaborate calculations, is to be found in the different deductions from the same data in the two statements of Messrs. Whistler and Jackson. The former has proved that in proportion to the adhesive force the performance of each engine, was as it should be—equal. The latter has proved that in proportion to the weight upon the drivers the *Suffolk* carried 16,314 pounds more than the *America ! !* showing the *Suffolk* to have possessed in this trial a "peculiar power" (independent of adhesion) to the amount of 8 tons and over.

But notwithstanding the close calculations of these performances, one important datum is omitted, and never hinted at. We refer to the gravity of the engines which on an inclined plane is part of the load as much as that of the tender or of one of the cars. The difference of the weight of the two locomotives is either 5,510 or 7,180 pounds as the first or second weight of the *America* is taken. This should have been added to the load of the *America* making an increase of about 3 tons.

The pressure in the boiler is only mentioned at the end of the paper, as being 90 pounds in the *Suffolk*, and 130 pounds in the *America*, whether this is intended as the average or not we cannot say, it certainly is not meant ~~to state~~ that this was the uniform pressure throughout the trial as this is manifestly impossible.

We have thus minutely criticized these reports as they are put forth for the very purpose of disabusing popular prejudice, and aiming at great exactness, it is necessary that such exactness should be established before the results can be relied upon. One thing is certain, that what is intended to be proved is not proved, and the whole argument and calculation falls to the ground. If the observations of Mr. Jackson are correct, there *is* such a thing as a peculiar power of engines independent of adhesion, as shown in the *Suffolk*, and therefore those who are in search of such a power can justly appeal to his statement to prove its reality. But if Mr. Whistler is correct, the addition of three tons extra weight carried up by the *America* destroys the balance and give a peculiar power to the *America*, showing a total disagreement of any of the results drawn from the experiments.

It may be thought that we have devoted too much time and space to the consideration of this subject, but when the importance of the discussion is considered, our professional readers will agree with us that it is of the highest importance, and deserving strict scrutiny. When popular error and absurd expectations are to be proven

upon the community, by those who produce facts which they claim to be strict and without the influence of such error and absurdity, a disproof of these facts is rather apt to increase the popular prejudice. Hence the caution with which such facts are promulgated should be extreme, and a good case made out before coming out.

If any of our remarks, which have been written in haste, and without much opportunity for revision, should be found inaccurate, we shall be greatly obliged for a correction. We always have professed and always have felt a desire for the promulgation of the truth, and are not the less inclined to it, when the correction of our own errors leads to such a result.

NEW YORK AND ERIE RAILROAD.

In a previous number we described the most northern of the three great railroad routes from New York city to Lake Erie, and presented profiles of each.

We now propose to make some remarks historical as well as descriptive relative to the second of the routes named, distinguished as the New York and Erie Road.

The attention of the public was first drawn to this route in the year 1839 by a pamphlet from the pen of W. C. Redfield, Esq. of New York city, a gentleman of enlarged views and scientific attainments, in which he proposed the construction of a railway, with a view of opening "a free communication at all seasons of the year between the Atlantic States and the Great Valley of the Mississippi." The city of New York on the East, and a point north of St. Louis, in the heart of the most fertile portion of the Mississippi Valley on the West, and designated as the two most important points to be united, and it was believed that a route nearly direct between these points could be obtained, which would pass north of the main body of the Allegany mountains, through the southern counties of New York, the northern portions of Ohio, Indiana, Illinois &c.

In May of the same year this project was examinned by E. F. Johnson, Esq. Civil Engineer, who took the same general view of the subject with Mr. Redfield, and in a communication prepared by him for publication discussed the merits of the project, entering at the same time somewhat in detail into a comparison of the relative merits of Railways and Canals.

The conclusion to which Mr. Johnson arrived on this latter subject may be stated in his own words as follows.

"That railways as a means of inter-communication, possess properties which in many situations will render them superior to

canals, and that with reference to the United States, Railways when properly constructed, will be found the most valuable and effective, and that ultimately when their merits become better known and more fully appreciated, by far the greater portion of the inland trade will be conducted upon them."

This declaration it will be observed was made within three years after the completion of the Erie canal and when the capabilities of railways as a means of general traffic and travel had not been tested by experience. It is, indeed, worthy of note, how nearly this prediction has been verified in the lapse of only 12 years. The railways now in operation in the United States exceed 3000 miles in extent, and yield according to the statistics of De Gerstner, on the average $5\frac{1}{2}$ per cent on their cost, after paying all expenses, and those in progress amount in the aggregate to about 2000 miles, while the canals at present constructing do not exceed, probably, one-fourth of that distance, and those which are completed are unable, with two or three exceptions, to sustain themselves and pay even a moderate interest on their cost.

To return now to our subject, Mr. Redfield published a second edition of his pamphlet in 1830, and in the same year a communication appeared in the Journal of Commerce from De Witt Clinton, Civil Engineer, in which a large portion of Mr. Johnson's remarks were embodied.

The latter were soon after published in full, in the Stateman, edited by Jno. I. Mumford, and subsequently were published by Mr. Johnson in pamphlet form, and distributed throughout the State at his own expense.

In 1831, the doctrine of internal improvement, by the general government, finding as it then did, considerable favor with the administration, Engineer Clinton was employed to make a reconnoisance of the country from the Hudson to the Mississippi, along the route of the proposed railway. His report was rendered in 1832, and exhibited in a satisfactory manner, the practicability of the undertaking, although the gneral features of the portion of the line within the State of New York were not quite as favorable as the friends of the project had anticipated.

In 1832, the charter of the New York and Erie Railroad Company was obtained, at the instance of several leading men in the city of New York, and in the interior of the State. This was the first important movement towards the accomplishment of the projected great line of railway, leading westward from New York city.

In 1834 the Legislature appropriated $15,000 towards a survey

of the route. This survey was entrusted to B. Wright, Esq., whose report was made to the Legislature in the winter following. By this survey the distance from Tappan to Lake Erie was 483 miles, which with 24 miles to continue it to the city, made 507 miles for the length of the road, which distance it was stated might be reduced 10 to 15 miles or say, 495 miles in all. The cost of the road for a single track from Tappan to Lake Erie, was estimated at $4,762,260 or about $10,000 per mile. The survey proceeded from the Hudson river to the Ramapo near the New Jersey line, thence along the Ramapo valley, crossing the Delaware and Hudson canal, *through the interior* of Sullivan county to the Delaware river—along that river to Deposit—thence across to the Susquehanna at Binghamton and along the valley of that river, the Chemung, Canisteo and Allegany to lake Erie. The maximum acclivity of the grade lines on this road varied from 60 to 100 feet per mile, with an inclined plane for the use of stationary power near lake Erie of 506 feet elevation.

In August, 1835, Moncure Robinson and Jonathan Knight, Esq., Civil Engineers, were called to consult with Judge Wright. These gentlemen did not undertake to suggest any changes in the route surveyed, but in their joint report recommended the use of auxiliary engines upon the steeper grades, the construction of a tunnel at the Shawangunk ridge and the avoidance, if possible, of the inclined plane near lake Erie.

The estimated cost of the road was increased, and in this consultation $315,000, making the total $5,077,200.

It may not be amiss to stop a moment here, to say that it was in this year, that the celebrated act was passed, for the prosecution of the most hopeless project ever undertaken in the State, viz. the enlargement of the Erie canal—this year is famous, also, for the *ex-parte* report made by the Engineers then in the employ of the State, on the comparative merits of canals and railroads, giving of course the preference to the former.

Both the enlargement project and the report, were at the time severely criticised, the former in pamphlet form, and the latter in the Railroad Journal, the authorship of both which productions has been attributed to Engineer Johnson.

In the fall of this year, the grading of forty miles of the New York and Erie Railroad, from Calicoon to Deposit, along the Delaware river was advertised for and put under contract. The company also fixed the termini of the road at Tappan (now Piermont) on the Hudson river and at Dunkirk on lake Erie. The duties of

President of the company at this time, devolved upon Jas. G. King, Esq., of New York. The subscriptions amounted to $2,382,00 and the first annual report of the company was issued.

In 1836 the Legislature granted to the company a loan of the credit of the State to the amount of $3,000,000, which the company was to receive in two or three instalments, as certain divisions of the road should be completed.

This act of the Legislature gave to the New York and Erie Railroad a permanent place among the leading public works of the State.

Its ultimate construction was considered by its friends no longer doubtful, and as this event is an important one in its history, we shall avail ourselves of the circumstance, to terminate our remarks here for the present, to be resumed, however, in the next number.

The great length of the following report, has obliged us to present to our readers only those portions which give general views. It will be seen that great advantages will result from this investigation, to the present line of road, by doing away with all the inclined planes.

The successful examination of this intricate portion of country reflects great credit upon Mr. Schlatter, and his principal assistants, Messrs. *Stocker*, *Fox* and *Roebling*, who are deservedly complimented in the report.

SECOND REPORT OF CHARLES L. SCHLATTER, PRINCIPAL ENGINEER IN THE SERVICE OF THE STATE OF PENNSYLVANIA, TO THE CANAL COMMISSIONERS, RELATIVE TO THE CONTINUOUS RAILROAD FROM HARRISBURG TO PITTSBURG, (Read in Senate, Jan. 15, 1841.)

To the President and Board of Canal Commissioners:

GENTLEMEN:—Since my appointment of August 1, 1839, as Engineer, directing the surveys for a continuous railroad from Harrisburg to Pittsburg, instrumental examinations and locations upon the several routes, which were selected as presenting the most favorable features for a line of railroad, without inclined planes, have exceeded one thousand and sixty miles. Reconnoisances, to a great extent, have also been made on *nearly all* the routes which were recommended to my notice by citizens residing in the several counties, lying between the Susquehanna river and Pittsburg. I regret exceedingly, that I am not able to say *all* the routes, for I was most anxious that every one between the Susquehanna river and Pittsburg, which upon reconnoisance, appeared at all practicable, should be submitted to the test of instrumental examination, if only for the purpose of satisfying the minds of those citizens who are interested in the course of the projected railroad, and who call loudly for such information as will convince them, either that they have recommended the course of the best route on which the rail-

road should be constructed, or that they have been mistaken in their conclusions, when believing that the most feasible route is that in which they are interested.

The limited amount of the funds appropriated, prevented me from extending the surveys as far as I had intended; but by confining myself to what appeared the most practicable routes, I have been enabled to complete continuous lines from Harrisburg, to Pittsburg, by three grand routes, designated in my report of last year, as the Northern, Middle and Southern routes.

A recapitulation of the prominent features of these routes, will prevent the necessity of referring to the description given in my report to your Board, December 27, 1839.

A more minute detail will be given hereafter, whilst describing the progress of the surveys on each route.

THE NORTHERN ROUTE

commences at Harrisburg, and follows the valley of the Susquehanna to Northumberland, thence by the West Branch to the mouth of the Bald Eagle creek, and by the valley of the Bald Eagle, and one of its tributaries, to the summit of the Allegany mountain, where it passes through a depression known as Emigh's Gap, from thence descending the western slope of the mountain, it crosses the Moshannon creek, passes to the Clearfield creek, and follows that stream to its junction with the Beaver Dam branch, thence ascending the Beaver Dam branch, crosses the head waters of Chest creek, to the head waters of the Black Lick, descends the Black Lick, crosses the Conemagh near Blairsville, and pursuing a very direct course through Westmoreland county, strikes the Monongahela river at the mouth of Turtle creek, whence it is carried by the eastern shore of the river to Pittsburg.

THE MIDDLE ROUTE

will occupy the same ground as the northern route, from Harrisburg to the mouth of the Juniata river. Thence it diverges, and follows the valley of the Juniata river to its junction with the Little Juniata. By the Little Juniata and Sugar run, it attains the summit of the Allegany mountain, whence it passes west, through a depression two miles north of the Portage Railroad, known as Sugar Run Gap. From this point, two sub-routes have been surveyed; one by the Conemaugh, running nearly parallel with, and using a portion of the Portage Railroad, the other pursuing the course of the Black Lick; both routes crossing the Conemaugh, and joining the Northern Route near Blairsville, follow the line already described, to Pittsburg.

THE SOUTHERN ROUTE

is that projected from Chambersburg to Pittsburg, passing through the counties of Franklin, Bedford, Somerset, Westmoreland, and Allegany.

This route was surveyed by order of the Board of Canal Commissioners, by Hother Hage, Esq., principal engineer in the service of the State of Pennsylvania, during the summer and fall of 1838,

and a line of railroad located, upon which no grade exceeded sixty feet per mile. This line, upon examination has been adopted, with but few variations; and the estimates, gradients and curvatures, with little alteration from Chambersburg to Laurel Hill, have been embodied in the material forming that portion of my report which relates to this route.

The surveys on the Southern Route, include the location of a M'Adamized road from Loudon, in Franklin county, to Laughlinstown, in Westmoreland county, prosecuted in accordance with a provision in the sixth section of "An Act to provide for continuing the improvements of the State, etc., viz: To complete the Survey of a railroad from Harrisburg to Pittsburg, * * * * * * and the engineer surveying the same, in connection therewith, is hereby authorized to make a survey to ascertain the practicability of a M'Adamized road of an easy grade, from some point at or *near* Chambersburg, to a point west of Laughlinstown." The perfect practicability of this road, has been ascertained, and the distance by the line surveyed with no gradient exceeding two and a-half degrees, (or two hundred and thirty feet per mile,) only exceeds that by the old turnpike, eleven miles.

The practicability of forming the road from Loudon to Chambersburg, is so well known, that I did not deem it necessary to carry the surveys farther than Loudon.

Owing to the great extent of the lines which have been surveyed, and upon which it will be necessary to make careful estimates of the cost, I shall not be able to lay before you the maps, profiles, estimates and comparisons upon the several routes, before April, when you will be enabled, beyond a doubt, to ascertain the various merits and demerits of each line, and to decide from facts which cannot be disputed, the route which should be recommended to the attention of the citizens of Pennsylvania. Local advantages and local interests, do not, in my opinion, properly pertain to the department of an engineer. Holding this opinion, and having been left untrammelled by intermediate points, between the place of starting and the destination of the road, I have endeavored, as far as lay in my power, to discover the nearest, cheapest, and best route for a railroad *between Harrisburg and Pittsburg*. It remains with your Board to decide which route would prove most *beneficial to the interests of the State*, as it is by no means certain that the shortest road would prove most profitable, for the resources of the country which may be developed by the longer line, might counterbalance and even exceed the advantages gained in distance, by the shorter, while many other benefits might arise in the course of the investigation between the rival lines, which may place the longer route in a position to be the most conducive to the prosperity of the Commonwealth.

The surveys this year were commenced early in the season, and as it was very uncertain that a further appropriation would be made by the Legislature, I directed the three corps of engineers, under my charge, to commence their operations on the *Middle* Route, as that route was undoubtedly the shortest, and I was desirous to lay

before your Board, at least one continuous line from Harrisburg to Pittsburg. As soon as it was known that a further appropriation was made for the prosecution of the survey, I removed two corps from the middle route, and placed one on the northern, and one on southern route. This delay was caused by the time consumed by one corps on the middle division, prevented me from pursuing the plan I had proposed of surveying the West Branch of the Susquehanna, from the mouth of the Bald Eagle creek to its sources in Indiana county, thence down the Two Lick and Black Lick creeks, to Blairsville, there to join the route already described to Pittsburg. I do not consider the northern route as being in a fair condition for comparison with the other routes until this portion is carefully surveyed, for it is well known that although the distance will be considerably increased over the route I have surveyed by the Clearfield, Chest creek and Black Lick, yet the summit is much lower, and the route will possess the advantage of less rise and fall, and lower gradients. The number of miles which remain to be surveyed from the mouth of the Bald Eagle creek, to join the surveys on the Black Lick, will not exceed one hundred and fifty miles.

On the southern route many surveys might be made connecting with the middle route, which would develope the resources of the country to a great extent, and the valuable and documentary evidence of the practicability of making railroads, which would prove profitable to a section of the State where so few public improvements have been made. My attention was directed by committees appointed at public meetings, to several routes which were recommended as possessing great advantages. My time was so constantly occupied in visiting the several corps engaged in field duty, and in reconnoisances upon the main lines, that I found it impossible personally to inspect all the routes recommended to my attention.

The following list exhibits the most prominent lines remaining yet to be surveyed, appertaining to the southern and middle routes:

From Petersburg on the Susquehanna at the mouth of Little Juniata creek, through Sherman's valley, passing the Tuscarora mountain, to the big Aughwick, and by that stream to the Juniata river. This route lies in Perry and Huntington counties, and the distance estimated as requisite to be surveyed, so that its practicability can be tested, is forty miles.

The next route is from Sideling Hill to the Juniata by way of the Big Aughwick creek; the line to be snrveyed lying altogether in Huntingdon county—distance to be surveyed estimated at twenty miles.

A route is proposed from Bedford to Johnstown, by Stony creek, passing through Bedford, Somerset and Cambria counties—distance to be surveyed estimated at fifty miles.

A route between Bedford and Cumberland, to connect with the Baltimore and Ohio Railroad, by way of Buffalo creek, was strongly recommended to be surveyed—this distance will be forty miles.

The survey for a route between Somerset and the junction of Jacobs creek with the Youghiogheny, connecting with Pittsburg by the line located for the Baltimore and Ohio railroad, has been estimated at sixty miles.

The survey for the line from Ligonier to Johnstown was commenced, and fifteen miles instrumentally examined during the past season. The necessity of finishing the continuous line on the middle route from Petersburg on the Juniata river, to Huntingdon, compelled me to relinquish the survey until more time was allowed for its prosecution. Fifteen miles is the distance estimated to complete the connection between Ligonier and Johnstown.

On the middle route there remains about seventy miles to be surveyed for the purpose of ascertaining, if it be practicable, to shorten the line in a few places. The route by which the greatest distance may be saved, is proposed to be surveyed from Petersburg, near the mouth of the Little Juniata, Huntingdon county, to Lewistown, Mifflin county, by the way of Sharer's run, Belleville and the Kishacoquillas valley. If this route should be found, upon examination, to present favorable features, a distance of ten miles may be cut off from the middle route, and the whole distance from Philadelphia to Pittsburg reduced to three hundred and thirty-eight miles.

On the northern route many lines have to be instrumentally examined, the most important of which is that extending from the mouth of the Bald Eagle creek, Clinton county, up the west branch of the Susquehanna to its source in Indiana county, and thence by the Two Lick creek to the line already surveyed on the Black Lick. By this line I feel now convinced that much lower gradients can be obtained than by the route I have examined, although the distance will be increased considerably; how much I am not now prepared to state, but the distance will, I think, be more than counterbalanced by the saving in rise and fall, and the obtaining of more favorable gradients.

In my report of last year I gave you a list of routes to be surveyed, and have thus described the Bald Eagle and Nittany valley routes, projected to save distance:—"It leaves the Susquehanna at the mouth of White Deer creek, in Union county, and proceeding up the valley of this stream, passes through the Nittany mountain, at the T spring, head of Big Fishing creek, thence descending on the slopes of the Nittany mountain and by the ridge skirting Little Fishing creek, to the table land of Nittany valley, thence through the Spring creek gap in the Muncy mountain to the valley of the Bald Eagle creek, where the line will unite with the route already surveyed at or near Milesburg"—distance estimated to be surveyed is forty-five miles.

The Penn's creek route is also described, in the report above alluded to, as leaving the Susquehanna at Selinsgrove, in Union county, and following the valley in Penn's creek, passes through the highly cultivated region on its borders, and by the town of Earlysburg, Bolesburg, Pinegrove, Gatesburg and Warrior's Mark, to the junction of the Little Bald Eagle and the Little Juniata—

thence by the valley of the first named stream to the vicinity of Hanna's furnace, where it unites with the route already surveyed. This route has the advantage over the route by the West Branch and Bald Eagle, it being about twenty-five miles shorter—distance estimated to be surveyed is ninety miles.

The whole distance remaining to be surveyed, to establish the routes as far as ascertained, is five hundred and sixty miles.

The above enumerated routes proposed for examination pertain to the line of survey for a continuous railroad from Harrisburg to Pittsburg. I would wish most earnestly to call the attention of the Board, also to the necessity of ascertaining the practicability of constructing a railroad from a point on the proposed line of railroad from Harrisburg to Pittsburg, on the Conemaugh at or near Blairsville, to Erie, on lake Erie.

Previous to entering upon a detailed description of the routes, I would wish to express the entire satisfaction I feel in the manner in which the several surveys have been conducted by my principal assistants, Messrs. J. C. Stocker, S. M. Fox, and J. A. Roebling, and the corps under their immediate charge. Living almost entirely in tents, and traversing for the greater part of the time occupied by the survey, the wildest portions of our State, they pursued their laborious occupation with a steadiness and perseverance which overcame every obstacle; and I am happy to state, that whenever an opportunity has offered for testing the work done, (and these opportunities have occurred more frequently on this than upon any survey upon which I have been engaged,) the accuracy with which the levels and the compass lines have joined, prove the care and skill shown by the parties employed on the survey.

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The route for a continuous railroad which will connect Harrisburg with Pittsburg by the shortest distance, and with the least expense, has been found to be that already noticed as the middle route.

The results of the surveys on this route have proved so much more favorable than I had any reason to expect, that I am induced to give to your board a more detailed description than I had intended in this report. The importance of the discovery of a line of railroad from the canal at Huntingdon, in Huntingdon county, to Johnstown, in Cambria county, by which *all the inclined planes* on the Portage railroad can be avoided, with an increase of distance of *only four miles* over the route by the canal and Portage railroad (without any inclination exceeding *forty-five feet per mile*,) also induces me to enter more minutely into the details of the surveys than this report would otherwise warrant; as I had intended only giving a general description of the manner in which the surveys had been conducted, with their results, leaving for my last report, when the estimates, maps, profiles, &c., should be delivered to your board, and all the details of the line surveyed.

* * * * * *

The report next proceeds to describe the Conemaugh route, by which the inclined planes on the western side of the mountain can

be avoided, and the distance from the summit of the Allegany to Johnstown increased but one mile, which we are obliged to omit, with the exception of the following paragraph:—

An important discovery has been made connected with this portion of the Conemaugh route, and independent of its interest to the general survey. It is that three of the inclined planes at present used on the western side of the mountain can be avoided. Our line at the foot of Plane No. 4, is only twenty feet below it, and the ground is gently sloping; a connection between the plane and the new survey could be made at this point in a distance of six hundred feet. From thence to Johnstown, a distance of 21.50 miles, by making only twelve miles of new road, over ground of very favorable character, at a grade of 44.88 feet per mile, the Plane Nos. 1, 2 and 3, could be dispensed with.

The following Table exhibits the rise and fall, distance, and highest gradient upon the three grand routes surveyed between Harrisburg and Pittsburg.

Names of Routes.		Rise in feet.	Fall in feet.	Distance in miles and decimals.	Highest gradients in feet per mile.
Northern Route,		2840.51	2408 51	320.61	45.00
Southern Route,	Hage's Line of 1838,	5254.00	4825.00	294.42	60.00
	Line surveyed in 1839, and 1840,	5073.00	4671.00	274.50	110.00
Middle Route,	By the Conemaugh,	2742.06	2301.02	248.64	45.00
	By the Black Lick,	2807.53	2375.50	242.86	45.00

PRELIMINARY REPORT ON THE SURVEY FOR A M'ADAMIZED ROAD FRGM LAUGHLINSTOWN TO CHAMBERSBURGH.

The great importance attached to this road induced me to direct Mr. Roebling, (the principal assistant detailed for this duty,) to conduct the survey in precisely the same manner in which our railroad surveys had been made, and to establish a regular system of gradients, in no instance, if practicable, to exceed an inclination of two and a-half degrees, or two hundred and thirty feet per mile. It was expected that a road passing over the Laurel hill, Allegany mountain, Ray's hill, Sideling hill, Scrub and Cove mountains, with such light gradients, would naturally exceed in distance the old turnpike, which is carried over the mountains with inclinations of four and a half and five degrees. The increase of distance, however, has fallen far below our first calculations, as by the line located, this increase is found to be only eleven miles.

From the great care with which the lines have been surveyed, it is believed that the best route for a M'Adamized road between Laughlinstown and Loudon has been traced. The interest of the towns and villages along the old turnpike may operate in some instances to change the direction of the line surveyed, but as no intermediate points were fixed by the act authorising the survey, the route was chosen which was the best and most direct, without any reference whatever to the old turnpike.

In my final report it is my intention to notice at length where the road may deviate from its located course, in order that it may pass through the towns and villages on the old turnpike. The maps which will be handed to your board, with that report, will show the course of the old turnpike and the projected M'Adamized road, together with all the proposed intersections and points of divergence.

The surveys this year commenced on the summit of Laurel hill, as a line for a M'Adamized road from Laughlinstown to the summit, had been surveyed the previous year whilst tracing experimental lines for the railroad.

The line crosses the old turnpike at the summit of Laurel hill, and turning south, does not again touch it until it arrives at the summit of the Allegany mountain.

The peculiar features of Somerset county, which have directed the general course of the route lying between the two mountains, and of which I shall take an opportunity of describing more in detail in my final report, caused the general course of the line to pass nearly parallel with the old turnpike at a distance of about two miles.

Mr. Roebling thus describes the surveys in his communication to me last October:

Our line descends the eastern slope of the Laurel hill with the maxium grade of two and a-half degrees, (or two hundred and thirty feet per mile,) and heads some branches of the beaver dam run which forms a branch of the Quemahoning. The same valley conducts the line to the forks of the Quemahoning. Thence a ridge is passed which divides the waters of the Quemahoning from those of Stoney creek. A small branch of Stoney creek, also named Beaver run, forms a valley by which our line continues several miles to a neck of high table land, included by the fork which the Beaver run and Stoney creek form above Stoystown. This high flat is crossed in a favorable manner, and the passage of the Stoney creek effected near the mouth of Mastaller's run. Leaving Stoney creek and ascending one of its branches, the Laurel run, we pass over a summit and descend to Clear run, another branch of Stoney creek. The valley of Clear run then offered the best opportunity of attaining the summit of the Allegany mountain in a course nearly straight and with no grade exceeding two and a half degrees, without losing any distance in consequence of grading.

The summit of the Allegany is passed about one and a-half miles south of the present turnpike. The line then descending with the maximum grade, intersects the old turnpike at the head of the Breastwork run. Thence the old turnpike is left to the right, and the new line, taking advantage of the mountain slope, descends two and a-half degrees to the foot of the mountain. The valley was then followed to Bedford, in order to avoid the Chesnut ridge and Mill ridge near Schellsburg. From Bedford, the valley of the Raystown Branch of the Juniata is pursued along the old turnpike to the Crossing. Here a deviation from the course of the old turn

pike became again necessary, to enable us to ascend Ray's hill without losing distance. This has been effected in a very easy manner by turning up the main draft of that ravine by which the turnpike is located.

To convey a correct idea of the location of the line over Sideling hill, and that most difficult ground to Scrub mountain and Scrub ridge, would require a more minute description than would be necessary in this report. Suffice it here to remark, that the whole extent of country from the Juniata to Cove mountain, where most difficulties are united, has been so thoroughly examined, that I believe no better line can be found than the one actually surveyed. We have obtained favorable lines and grades without any material increase of distance over the present turnpike.

The greatest obstacle on the whole route is Cove mountain, particularly the eastern descent which amounts to fifteen hundred feet. The western ascent has been effected without much difficulty, but not so the eastern slope, down which the line was graded six and a half miles, in order to overcome the fall.

The line terminates at Loudon, at the eastern base of Cove mountain. The whole distance from Laughlinstown is ninety-eight miles. The present turnpike measured eighty-seven miles, therefore eleven miles less. This increase of distance on the new line is altogether owing to the reduction of grades in passing the mountains. Between the mountains we have generally saved distance.

In comparing the two lines, we should chiefly fix our attention upon the gradients. There will be a *virtual* saving of distance in the new line of at least one-third for heavy wagoning, and of one-fifth to a fourth for light conveyances. A light carriage will traverse the new line from Laughlinstown to Loudon conveniently in twenty hours running time, provided the road is kept in good order. The old turnpike requires at the least thirty hours. Well organized stages may run the whole distance from Laughlinstown to Loudon in twelve hours with certainty, and without working the horses harder than they are worked on the present turnpike. But the great difference in favor of the new route becomes fully apparent, when we consider the increase of load the wagons will be capable of hauling upon the new line. The heaviest load a good six horse team can haul over the present turnpike is seventy-five hundred weight. Intelligent wagoners with whom I have conversed on this subject, have assured me that they can load one-half more *at least* on a road with inclinations of two and a half degrees, and drive over in less time than they do on the present road.

The maps profiles, and estimates of all the routes surveyed are now rapidly progressing under my direction. The large map which was exhibited in the hall of the Legislature last year, and upon which the routes, as far as they were *then* surveyed were delineated, has been this year used from motives of economy to exhibit the routes surveyed during the past season. This map will be placed in its former position in a few days, when all the routes dea-

cribed in this report can be easily traced, and as the data upon which the map was formed, has been furnished from actual surveys made by engineers in the State service, it is believed that it will furnish more correct geographical information than any map which has been made of that portion of the State of Pennsylvania between the waters of the Susquehanna and the Ohio river.

Your obedient servant,

CHARLES L. SCHLATTER, *Chief Engineer.*

Harrisburg, Jan. 9, 1841.

APPENDIX.

The following list will exhibit the distances by railroads already made, in progress, and contemplated, between Cleveland and Erie (on Lake Erie,) and Boston, New York, Baltimore, and Philadelphia:

	Miles.	
From Boston to Albany, via the Boston and Worcester, and the Western railroad,	200	
" Albany to Buffalo,	318	
" Buffalo to Cleveland,	210	
" Boston to Cleveland,	—	728 miles.*
" New York to Buffalo by the Albany railr'd,	474	
" Buffalo to Cleveland,	210	
" New York to Cleveland,	—	684 miles.†
" Philadelphia to Cleveland by the Pennsylvania canals and railroads, via Pittsburg and Beaver to Erie, and from Erie by the lake to Cleveland,		682 miles.
" New York to Dunkirk by the New York and Erie railroad,	484	
" Dunkirk to Cleveland,	170	
" New York to Cleveland,	—	654 miles.‡
" New York to Philadelphia, via the New Jersey railroads,	85	
" Philadelphia to Cleveland by the railroads now in use, and by the projected railroads from Harrisburg to Pittsburg,	478	
" New York to Cleveland,	—	563 miles.‖
" Philadelphia to Pittsburg by the Philadelphia and Columbia railroad, and the Lan-		

* On the Western railroad the grades rise from sixty to eighty feet per mile.

† On this route the gradients rise as high as ninety feet per mile.

‡ on the New York and Erie railroad the gradients are sixty feet per mile in many places.

‖ On the railroad from Philadelphia to Pittsburg, it is now well ascertained that no gradient will exceed forty-five feet per mile, and the section of country lying between Pittsburg and Cleveland has been so thoroughly examined with a view to the formation of canals, that no doubt can exist of the practicability of making a railroad between the two points with still lower gradients than have been obtained between Pittsburg and Philadelphia.

	caster and Harrisburg railroad, and by the route as surveyed in 1839 and '40,	348	
"	Pittsburg to Cleveland,	130	
			— 478 miles.
"	Baltimore to Pittsburg by the Baltimore and Ohio railroad,	340	
"	Pittsburg to Cleveland,		— 470 miles.*
"	From Philadelphia to Erie, via Reading, Little Schuylkill, Catawissa, and Sunbury and Erie railroads to Erie; Lake to Erie, as reported by Edward Miller, Esq., C. E.		555 miles.

ROUTES TO ERIE.

"	Philadelphia to Blairsville by the Middle Route,	306	
"	Blairsville to Freeport,	42	
"	Freeport by Buffalo creek, via Meadville, to Erie, estimated at	130	
"	Philadelphia to Erie,		— 478 miles.

If the above route should not prove practicable, no doubts can be entertained that the line of railroad could be carried by the canal route surveyed in 1826, by the engineers employed in the State service, from the mouth of the Kiskiminetas to Waterford, by the Allegany river and French creek. From Waterford a line has been located for the Sunbury and Erie railroad by Mr. Miller. By this route I estimate the distance from Philadelphia to Erie at 490 miles.

It will be perceived from the foregoing statements that Philadelphia has the advantage in distance over the city of New York by the nearest routes from Cleveland, passing through the respective States in which those cities are situated, of 166 miles.

The advantage over Boston in point of distance is 250 miles.

Baltimore is eight miles nearer than Philadelphia to Cleveland, by the Baltimore and Ohio railroad, but the advantage in gradients is decidedly in favor of the route to Philadelphia, through Ohio and Pennsylvania.

DEATH OF CLYNTHUS GREGORY, L. L. D. We omitted mentioning in our last, the decease of this distinguished man, in the 67th year of his age. The labors of Dr. Gregory have all been of a practical character, and have given him a high reputation.

ERRATA.—In the No. for March 15th, page 164, 8th line from top, insert *Menai Bridge*, in place of " Vienna Bridge. On the same page, 14th line from top, read 32,000, *Thirty-two thourand*, in place of " 52,000."

* Upon the Baltimore and Ohio railroad the gradients at two points exceed eighty feet per mile, and for over thirty miles are as high as sixty feet per mile.

THIRTEENTH ANNUAL REPORT OF THE PRESIDENT AND DIRECTORS TO THE STOCKHOLDERS OF THE BALTIMORE AND SUSQUEHANNA RAILROAD COMPANY. (December 15th., 1840.

The president and directors of the Baltimore and Susquehanna Railroad Company, submit to the stockholders a report of their proceedings during the year, ending on the 30th September, 1840.

Our last annual report apprized the Stockholders of the difficulties which had rendered the act of Assembly of December session, 1838, chap. 395, unavailable for the relief of the company. By the provisions of that act, a loan of seven hundred and fifty thousand dollars, was to be made by the State, to the company, for the purpose of enabling us to complete both our own works, and a portion of the Wrightsville, York and Gettysburg Railroad; but when the act had been accepted by the company, notwithstanding the objections which many of the stockholders entertained to its provisions, it was found that one of its restrictions, prohibiting a sale of the State five per cent. stock for a less price than its nominal par value, deprived the company of the benefits which it was the object of the act to afford, as the commissioner of loans was unable to effect sales of the stock to any great extent at that rate. Application was made to the legislature at their last session to remove this restriction; and in pursuance of the resolutions adopted by the stockholders in general meeting, on the 4th June, 1838, the memorial presented by the board, likewise represented the views entertained of other provisions of the act by the individual stockholders in the company, and solicited a modification of them. By the act of December session, 1839, chap. 20, the legislature authorised a six per cent. stock, to be issued in lieu of the five per cent. stock; but no other change in the features of the law could be obtained. The same limitation, however, on the sale of the new stock was again prescribed, and the stocks of the State having all been throughout the year somewhat below par, the commissioner of loans has only been able to dispose of the stock issued for this company, by receiving in payment for it the claims of such of the creditors of the company as were willing to purchase the stock at par to the amount of their respective claims. This, however, has been done to so great an extent, that the debts of the company, except those for interest due the State and city, have been reduced to a comparatively small amount; and to meet them, the stock still remains in the hands of the commissioner. The act last mentioned, also reserved out of the stock to be issued, an amount equal to the interest due by the company to the State, to the 1st of January, 1840.

In the month of April last, the long sought communication with the Pennsylvania improvements, by an unbroken line of railroad from Baltimore to Columbia was at length obtained; by the completion of that portion of the road of the Wrightsville, York and Gettysburg Railroad Company, which extends from York to Wrightsville. By agreement between that company and this, the locomotives of the Baltimore and Susquehanna Railroad Company run to Wrightsville; and hitherto the whole transportation on the road has been done by them. To the trade of Baltimore the same facilities are thus given as if this company had succeeded in directly carrying into effect their original design, of constructing, under the authority of the single charter, a railroad "from the city of Baltimore to some suitable point or points on the Susquehanna River." We have, therefore, now to congratulate the stockholders on their having practically completed the enterprise in which they are zealously engaged, and in which they have persevered through difficulties and embarrassments, such as it has been the lot of but

few similar companies to encounter, and perhaps of still fewer to surmount.

Soon after the communication with the Pennsylvania canals, and the Columbia Railroad was thus opened, the transportation line of Messrs. D. Leech & Co., established a depot in Howard street, and made arrangements for running their cars regularly on tho road, carrying produce and merchandise between Baltimore and Pittsburg, or other points on the line of the Pennsylvania works. At a later period Messrs. Bingham & Brothers opened a depot in the same neighborhood, and placed their line on the road. During the fall the proprietors of the Portable Boat Line also made preparations to use this route; but no cars of this line have yet run on the road, though some freight has been forwarded by its agents. Besides these lines, Messrs. Jas. O'Conner & Co., whose portable Car Body Line commenced business on the road as soon as it was completed to York, as mentioned in our last annual report, have kept their line regularly in operation throughout the season, running from their depot in North street. The Emigrant Line of Leech & Co., has continued to forward that class of passengers for Pittsburg to Wrightsville, in the cars of the company.

The whole amount of transportation over the road by the three lines of Messrs. O'Conner, Leech and Bingham, from the 1st October, 1839, to the 1st October, 1840, has been,

Transported Eastward, 7,078,734 lbs., equal to $3{,}539\frac{734}{2000}$ tons.
Transported Westward, 6,329,662 lbs., equal to $6{,}314\frac{1662}{2000}$ tons.

Total, 13,708,396 lbs., $6{,}854\frac{396}{2000}$ tons.

This trade was all carried on with places beyond Columbia, and nearly, if not quite the whole of it, with Pittsburg.

In addition to the regular transportation lines, the plan adopted by the company, of permitting cars, owned by individuals, to pass over the road, paying a certain rate for toll, and for the motive power furnished by the company, has had the effect of bringing trade on the road, which otherwise would probably not have sought this market. This being the system pursued exclusively on the Philadelphia and Columbia Railroad. Many persons who have occasion to transport extensively on that road, are provided with their own cars, and these being loaded with produce, its owners have now the option of sending them either to Philadelphia or Baltimore. Within the last few months, not only have cars reached Baltimore from places situated on the State road, at a considerable distance beyond Columbia, but others have made repeated trips to this city from the Harrisburg Railroad, and from Carlisle and Chambersburg. The route taken by the latter is by the Cumberland Valley railroad, which extends from Chambersburg to Harrisburg, by the Harrisburg, Portsmouth, Mount Joy, and Lancaster railroad, and the Philadelphia and Columbia railroad. This trade has but lately commenced, but seems likely soon to become of an important magnitude.

The Revenue of the Transportation Department, from 1*st October*, 1839, *to the* 30*th September*, 1840, *has been, from*

Passengers, 36,162,	$45,561 23
Merchandize, 62,097,089 lbs.,	74,225 98
United States Mail,	8,065 05
	$127,852 26

Of which collected from Passengers and Merchandize,		$118,152 14	
United States Mail,		5,876 30	
		$124,028 44	
Less amount outstanding, last report,		6,329 89	117,698 55
Outstanding, 30th September, 1840,			$10,153 71
Being for Merchandize,		$7,614 96	
United States Mail,		2,538 75	
		$10,153 71	
Total amount of Transportation,			$127,852 26
The expenses paid on account of Transportation for same period, have been		$92,273 32	
Less debts of last year paid,		8,757 88	
		$83,515 44	
Debts outstanding,	$5,372 39		
Less value materials,	3,439 87	1,932 52	85,447 96
			$42,404 30
Office expenses for the same period,			5,316 27
			$37,088 03
To which add two-thirds of the gross receipts on the W. Y. & G. railroad, for the estimated proportion of this Company, $10,862 91,			7,241 94
Nett,			$44,329 97

It will be seen that we add to the nett receipts of the company, our estimated proportion of the revenue received for transportation on the Wrightsville road. Our locomotives exclusively, have run over the road, and we have received all the revenue, charging generally about the same rates as between this and York. We are from this revenue to pay the Wrightsville Company for tolls for the use of the road, the same tolls which were in 1838 charged on the Philadelphia and Columbia railroad. The accounts between the two companies being not yet settled, we can only give an estimate of our proportion, which, however, we believe will be found to be less than the amount which we will be actually entitled to retain. The amount which has actually been paid to that company on this account. is $2,120 45. In the above statement of expenditures by the transportation department, are included all our expenses of transportation on the Wrightsville road.

From the foregoing statement it will be perceived, that, although there has been a considerable increase in the revenue of the company, as compared with the preceding year, it has not yet reached the amount which has been anticipated, and which must be realized before the company will be in a condition to discharge the annual demands of the State and of the City, for interest on their respective loans. That this has been the case, is the source of much regret, but we trust that the prominent causes which have operated to produce this result, will prove to be but temporary in their character, and the company will yet, ere long, be found in a position to meet all the engagements of every description, which it has assumed. It will

be remembered that almost simultaneously with the completion of the railroad to Wrightsville, was opened another communication between the city of Baltimore and the same point, by the Tide Water and Susquehanna canals. Although these works may have brought to the city, trade that would not otherwise have reached it, they have also had the effect, during the past summer, of diverting a part of that which would have passed over the Baltimore and Susquehanna railroad. In what degree the business of the railroad has been thereby lessened, we cannot say, but it must have been so to a considerable extent. But at the same time it may be doubted whether the effects of the construction of these canals will be permanently injurious to the interest of the railroad. The amount of trade which will be drawn to this city by the facilities offered by both lines of communication for its transit, may reasonably be expected to become much greater than Baltimore has heretofore enjoyed, and perhaps will be more than either line singly would have attracted. Of this new trade the road will have its full share and it may well happen, that both the canals and railroad will shortly be more fully employed than either would have been, had but the one route existed. These works having all been completed to Columbia last spring, cannot be supposd yet to have developed the results which they will produce; while by dividing the trade which was already prepared to avail itself of the advantages of these new routes, they have for the present, each rendered the other the less productive. It will be admitted too, that the trade from the city to the interior, which pays the highest rate of toll and freight, has not, during the past year, been by any means, so great as may be calculated on in periods of ordinary activity and freedom from commercial embarrassments. We believe, therefore, that it is reasonable to expect that the future revenue of the company will be found constantly to increase, and that even during the next year, it will greatly exceed that of the past.

The whole amount earned by the transportation department, beyond its expenses, we have not been able to make available towards the payment of interest to the State. Several parties who made use of the road for the transportation of produce and merchandize, (some of them to a great extent) were creditors of the company, and declining to purchase the State stock in satisfaction of their claims, the company were compelled to receive a large amount of their own obligations in payments for freight. Again, in repeated instances, in consequence of the disappointment of the creditors, by the inability of the company to meet their demands as was anticipated when the law of 1838 was passed, suits had been brought, and judgments obtained against the company, and the whole operations of the road were in danger of being interrupted by levies upon the property of the company, and suspended for an indefinite period, until the termination of an expensive court of litigation. Several claims of this character the company have had to extinguish during the year, and their only means of doing so was by the temporary appropriation to that object, of a portion of the funds derived from the revenue. It is not deemed necessary in this report, to enter more particularly into a detail of these circumstances, however embarrassing they have been to the operations of the company. We can, however, with confidence express our conviction, that in all the measures we have pursued, the true interests of the company have been consulted, and we feel assured that should a more particular statement of our proceedings be called for, either by the stockholders, or by the authority of any other party, having the right to make such inquiry, we shall be found to have discharged, with a proper regard to the interests entrusted to our care, the duties which devolved upon us.

On the Westminister branch, passenger cars have run to Owings' Mills throughout the season, but are withdrawn in the winter, as locomotives cannot be used on that track, and it could not consequently be kept clear of snow, except at an expense which we would not be justified in incurring. The time limited by law for the completion of the road to Westminister will shortly expire, and an application to the legislature, to extend the period will be necessary.

We have much pleasure in stating that the whole track of the road, from Baltimore to York, is now in perfect order; that part which at the date of our last report, was constructed with the plate rail, having since been entirely renewed with a heavy T rail, laid in a substantial and permanent manner. If the means of the company would justify a further expenditure in obtaining a passenger depot, within the city, and in improving their present depots by additional buildings, the comfort of passengers, and the facility of the company for carrying on its business, would be promoted; but without this, the company are now prepared to forward a much more extensive trade than has yet offered, and we do not therefore contemplate that any further expenditures will soon be required for those purposes. The soundness of the policy of constructing a railroad in a solid manner, with heavy rails, has received further proof by the experience of the year, in the small amonnt which has been required to keep the track in repair. This has cost for the twelve months, $10,378 35 for the whole distance of fifty-six miles; or on the average of $142 40 for each mile of heavy T rail, and $543 06 for each mile of the old plate rail track, which, until the month of August last, was the only one used for a distance of nearly six miles.

An unforeseen expenditure has been necessarily incurred this year, for arching a part of the tunnel on the York and Maryland line road, about five miles from York. Although this tunnel in its whole extent, passes through a rock, apparently solid, it was found that the operation of the frost at both ends of it, had last spring displaced several pieces of the rock, which fell on the track, and it was evident that the evil would continue to increase with each successive winter. To guard against a danger of so serious a character, strong arches have been constructed, extending at the northern opening of the tunnel, one hundred feet, and at the southern, thirty-two feet. The final returns of the cost of this necessary work have not yet been received, but it will be about six thousand dollars.

In the department of machinery, several improvements have been introduced, calculated to diminish materially the heavy annual cost of repairs. The principal of these consists in the substitution of cast iron wheels, with chilled tread, on the locomotives, for those with wrought iron tires which were before used; and which were found to wear so rapidly as to require frequent renewal, at a heavy expense. Chilled driving wheels of four and one half feet diameter have now been running on the road for six months, and have been found to answer perfectly; and from the success which has attended the experiment, other railroad companies, in different parts of tne country, have been induced to adopt the same improvement.

The regularity with which both the passenger and burthen trains have performed their trips since they first commenced running to York, has been such as to do the company much credit. On the occurrence of the extraordinary fall of snow in December, 1839, they were interrupted, as it is believed, were those on every road without exception, to which the storm extended. On the 1st of January last the company commenced carrying the mail, and from that day to the present, not a single trip has

been lost, and but in a very few instances, have the passenger cars been so detained by any cause whatever, as to fail to deliver the mail before the contract time. The snow storm on the 4th, 5th and 6th inst., was one of unusual severity; but the trains both from Baltimore and York were only detained by it for a few hours on the 6th; the trips on every day but that being made with punctuality. The snow was cleared away without the employment of any additional force, or any extra expense, except that for the fuel and oil used by the locomotives required to drive the snow ploughs.

The annexed financial statement will show the total receipts and disbursements of the company to the 1st of October, 1840.

By order of the Board,

CHARLES HOWARD, *President.*

A condensed financial statement of the Baltimore & Susquehanna Railroad Company, to 30th September, 1840.

RECEIPTS:

From Capital Stock,	$450,000 00	
From Loans of State of Maryland,*	1,829,379 55	
From Loans of City of Baltimore,	850,000 00	
From nett transportation received from Balt. and Susq. and York and Md. Line Railroad Co.'s	60,005 19	
From gross transportation on Wrightsville, York and Gettysburg Railroad; less amount paid that company on account,	8,742 46	$3,198,127 20

EXPENDITURES:

For Old Road,	$398,160 11	
For Stock York & Md. Line Railroad Co.	199,265 00	
For Construction do do	326,563 72	
For Graduat'n, Masonry & Construction,	631,328 49	
For Damages,	16,787, 92	
For Bridges,	115,797 96	
For Rail laying,	528,127 21	
For Timonium Division,	224,528 83	
For City Division,	59,877 01	
For Water Stations,	3,855 66	
For Office Expenses to Sep. 30,1839,	6,948 34	
For Salaries Pres't and Sec'ry do	9,491 30	
For Printing and Advertising, do	1,439 28	
For Legal advice,	6,312 45	
For Depots and Real Estate,	52,151 49	
For Locomotives,	106,920 04	
For Passenger and Burthen Cars,	77,628 55	
For Stock Wrightsville, York & Gettysburg Railroad Company,	120,150 00	
For Interest to State,	107,260 56	
For Interest to City,	57,500 00	
For Discount,	41,226 37	
For Loss on Sales City Stock,	18,421 72	
		3,109,742 01
Excess of Receipts,		$88,385 19

FUNDS AVAILABLE:

Cash and Agents,		$5,110 39
Bank Stocks,		3,436 43
UNAVAILABLE:		
Bills Receivable and Balt. and Susquehanna Railroad Stock,		29,015 31
Wrightsville, York & Gettysburg Railroad Company,		102,562 89
		$140,125 02
DEBTS:		
Sundry Credits on Books,	$4,471 03	
Bills Payable,	31,439 08	
Company $100 notes,	15,300 00	
Company $5 and 10 notes,	20 00	
Company $1 and 2 notes,	509 00	
	$51,739 83	$88,385 19

ROB. S. HOLLINS, *Secretary.*

*REMARKS:

Of the Loan from the State, chap. 395, 1838, *there has been issued to the* 1*st October*, 1840.

Of the 5 per cent. stock,	$88,710 97	
Of the 6 per cent. stock,	488,668 58	
		$577,379 55
Due to the State for interest to Jany. 1st, 1840, which is to be taken in stock,		112,500 00
Leaving yet to be disposed of, for the uses of the Company,		60,120 45
		$750,000 00

The practical character of Armstrong's work on steam boilers, has induced us frequently to refer to it. There is one portion, however, which is if possible of more utility than the rest, viz. that which refers to "priming," foul boilers, and sediment. Few works have treated so largely upon these points, and being at the bottom of more mischief than is usually suspected, these accidents or defects deserve more attention from Engineers than they have hitherto received. We shall therefore endeavor to select such portions of the work, as are most valuable upon this topic, and produce them for the benefit of our readers.

CAUSE AND EFFECTS OF PRIMING.

If a boiler were only required to generate a certain quantity of steam, and that always at an uniform rate, it would only be necessary to supply it uniformly with water, and by applying a regular heat, the desired result would be attained; but the case is very different to this in practice. From the necessarily intermittent action of the valves of all steam engines, the

supply of steam being momentarily cut off at each stroke, as well as for a considerable period during each stroke in those engines that work expansively, the effect is to throw the water of the boiler into an undulatory motion, as may at any time be perceived by observing its effect in the glass tube of the water gauge* now so generally attached to boilers.

This undulatory action of which we speak, is apparently independent of or at least in addition to, the intermittent state of alternate ebullition and repose before described. At any rate, from one of these conditions, or from both combined, it is certain that the agitation of the water occasionally becomes so violent as to cause the latter to follow the steam into the cylinder and when in too great a quantity to escape through the steam port in the return stroke, it infallibly breaks down the engine.

We speak of the effect thus positively as regards factory engines, because they are not, and cannot be expected to be, calculated to withstand a sudden blow, and such it is in reality. For if the water primes into the cylinder in sufficient quantity in the down stroke, it must remain on the top of the piston until it strikes against the cylinder cover in the up stroke, with more or less violence according to quantity. From the incompressibility of water, of course the effect is the same as if a piece of iron of equal thickness to the depth of water was suddenly inserted in its place. The tremendous effect sometimes produced when a large engine of 80 or 100 horse power breaks down from this cause, is a matter of notoriety in Manchester; for as the vacant space left at the top of the cylinder is generally of no greater depth in large than in small engines, the intruding body of water strikes the cylinder cover with a proportionally greater force. Generally the accident does not end with merely straining or breaking the crank pin, as is frequently the extent of the injury in small engines; but the momentum of the beam is then added to that of the fly wheel, and their combined force is exerted directly in splitting the cylinder, or tearing off the cylinder cover, thence effectually demolishing all the rods and gearing, in fact the main beam itself also sometimes gives way, leaving almost nothing whole except the fly wheel.

In analyzing the various causes concerned in the production of the effects above described, we must not overlook the fact that the tendency of the water to rise into the cylinder is always considerably promoted by the very usual situation of the steam or induction pipe at the back end of the boiler; this seems to arise partly from the constant circulation of the water, which causes a current at the surface, to set in the direction of the length of the boiler from the front end to the back.

This circulation of the water in a steam engine boiler, of course, takes place in all boilers, with a certain velocity depending upon the ratio that the intensity of the heat in the furnace bears to the quantity of water to be kept heated; and it is entirely independent of the other two causes before stated, but it is most probable that all three are combined in producing waves which take their rise over the fire and gradually increase in height as they pass towards the back part of the boiler; for it is a fact, although not generally known, even to workmen, that the water line or mark which is left by the surface of the water on the inside of the boiler is not level, but higher at the back end than the front, modified in some degree by the situation of the steam pipe.

* The *glass tube water gauge* is an appendage to boilers of so much use in testing the evaporating powers of different boilers, and in ascertaining the value of different kinds of fuel, or the merits of the various modes of firing, that it is a matter of astonishment how it is overlooked by any one; moreover, it is so well calculated to prevent accidents from a deficiency of water, that it cannot be too strongly recommended to all owners of high pressure engines.

The peculiar tendency of the water in a steam engine boiler, to rise into the cylinder, of which we have been treating, is well known to all experienced operative engineers, under the name of "priming," "flushing," "pumping," and other similar terms, but it has not been much adverted to by theoretical writers, nor is it yet looked to by steam engine and boiler makers with that attention which its importance deserves, although it is well known to most of them to be the principal if not the only thing which renders a large steam chamber necessary.

It is remarkable that when the inside of a boiler is examined immediately after the engine has primed much, marks are frequently found running in a slanting direction up the sides of the steam chamber towards the steam pipe, in nearly a direct line leading from that part of the surface of the water which is immediately over the hottest part of the furnace, just as if a partial explosion (if we may so call it) of the water had taken place in that part of the boiler and spent its main force in the direction stated. When there is any considerable quantity of mud or clay in the boiler, the marks indicating the direction of this explosion or flushing are particularly legible; and the effects of it, we have had many opportunities of observing in its forcible removal of heavy articles which had been placed in boilers for the purpose of preventing, if possible, the priming of the engine.

That waves are generated within the boiler when an engine is liable to prime, is a singular but well ascertained fact, as is shown by the frequent great and sudden depressions of the float at such times; especially if the latter happens to be placed at the contrary end of the boiler to that where the steam pipe is fixed. In watching the rapidly successive alternate elevations and depressions of the indicator buoy or float of a boiler in this condition, the tendency to prime may frequently be observed to recur periodically after intervals of a certain number of strokes, provided that the state of the fire and the load on the engine continue perfectly uniform.

Since the publication of Mr. J. Scott Russell's curious researches on the generation of waves in canals, it has occurred to us that his theory might possibly be applied to the illustration of the above singular phenomenon; and that if so, it will no doubt be found that the depth and form of the water chamber will considerably influence the law which seems to govern the periodical recurrence of this flushing of the water in the boiler. Those who have leisure and inclination to pursue this subject will find it an interesting field of inquiry, and far from being one of mere barren curiosity only, inasmuch as a few well directed experiments may lead to results calculated to unravel some of the still mysterious causes connected with the explosions of steam boilers; than which, no subject is more deserving of the aid of the funds of the British Association for the advancement of science, on account of the immense importance to the interests of humanity which it involves; and we know of no one half so well calculated both by talent and experience to elucidate that very perplexing and difficult subject than the gentleman above mentioned.

Although digressing farther than was intended, it may in order to point out the intimate connection of the two subjects alluded to, be just stated, that, we have known an instance of a very large safety valve (5 to 6 inches diameter) belonging to a high pressure engine that was liable to prime, which would always on being suddenly opened, discharge nothing but water, (although the latter had not previously been higher than usual,) to the great risk of the boiler becoming short of water and thereby creating an explosion; a fact which shows the inutility of very large safety valves, instead of two or three small ones of the same united area.

Although there are many boilers working with Tredgold's proportion

of steam room, and even with a much smaller proportion, all that we have been able to meet with belong to high pressure or non-condensing engines, or those in which the steam is very much throttled or wire-drawn: that is, the pressure is invariably a great deal higher in the boiler than in the cylinder, and in some cases nearly double, as the application of the Indicator* has invariably shown. Hence the uniform failure of all attempts to introduce high pressure engines for working the cotton mills in Lancashire, where examples of the low pressure, condensing, or Boulton and Watt engines, are so numerous as to be a ready test of their comparative economy.

From this cause mainly, we have the tampering with the safety valves, and, consequently, accidents continually occurring where high pressure engines are in use. In low pressure boilers, the method of meeting the difficulty of too small a steam chamber, by raising the pressure of the steam, is not practicable to any thing like the same extent, on account of the usual method of feeding the boiler with water by means of the ordinary feed pipe, which boils over when the steam is too high; but where it can be done at all it generally is. With marine boilers, which are supplied direct from the force pump, in the same manner as those of high pressure engines, it is practised to a considerable extent, and is in the highest degree reprehensible, considering the immense destruction of human life that has sometimes taken place by the bursting of the boilers of steam packets.

REPORT OF THE ENGINEER UPON THE SEVERAL DEFINITE LOCATIONS FOR THE HARTFORD, AND SPRINGFIELD RAILROAD:

HARTFORD, MARCH 2D, 1841.

GENTLEMEN:—In obedience to your directions I have surveyed and located four routes for your contemplated railroad, and approximately located two other entire lines, besides making preliminary surveys and examinations on several experimental lines and the different proposed terminations for your road to a great extent. After having made unremitted exertions since the commencement of this survey on the 18th of December last, it has been found impracticable to collect all of the necessary information in relation to the costs of lands and damage, or the great amount of local business upon the different routes, to enable you to select at this time that which shall subserve best the interests of the corporation and of the community at large; still I have the honor to present a mass of facts fully sufficient to settle the question of the great importance of this work, and of its entire practicability at a moderate expense within the present year.

1. THE EAST ROUTE.

This is indicated on the map by the most eastern full red line on the east side of the Connecticut river. It commences at a point on Front street in the north-eastern section of the city of Hartford; from thence it takes an easterly direction, crossing first the river above mentioned, then the extensive river flats on an embankment made of the average height of twelve feet in a direction transverse to the general direction of the stream at high water; then after cutting moderately into the table on which East Hartford

* The steam engine indicator, as improved and rendered extremely portable by Mr. Mc Naught, of Glasgow, is now well known in Lancashire; and it is really of so much use to the steam engine proprietor in enabling him to detect the effect of any alterations in the engine, as well as a good approximation to ascertaining the comparative load on engines doing a similar kind of work, that it is only surprising not to find it a permanent appendage to all engines.

is situated, it finds a position on the surface of the extensive East Hartford and East Windsor plains. From this point the line sweeps around to the north, after which it may be laid on an easy grade nearly straight for about sixteen miles, and until it arrives at the diverging point of two lines, situated as shown on the map three-fourths of a mile east of the manufactories at Thompsonville. The only variation made in the line from its direct course has been for the purpose of passing the Podunk and Scantic rivers at their least expensive crossings. From the diverging point above mentioned, the most eastern line, after encountering a succession of deep cuts and corresponding embankments, arrives east of the Longmeadow church, then turning on a radius of large dimensions, it lays its northern tangent nearly in the direction of the contemplated depot in the south part of Springfield; curving more westerly from this point it unites with the Western railroad without serious inconvenience to the valuable property in the vicinity of which it passes. This tangent just mentioned crosses the valley of Pecowsic brook at its most favorable point; still it is necessary, even on the maximum grade of thirty feet per mile, to cut into the northern edge of the plain bounding this valley, to the depth of fifty feet: a small portion of clay undoubtedly and perhaps quicksand will be encountered in this excavation. From the diverging point before mentioned, the most western route passes with easy curves on the table land that projects at an altitude of about forty feet from the west edge of the plain, which forms the eastern boundary of the low lands of Longmeadow; finally, after cutting its way through the projecting bluff at the mouth of Pecowsic brook, passing over the saw-mill on that stream, laying its embankments above and beyond the reach of the highest floods, it curves moderately, and unites with the line just described.

2. EAST ROUTE ON THE EAST BANK OF THE RIVER.

This line occupies the ground upon which Mr. Twining approximately located his eastern route with the exception of a portion of the line at Warehouse Point, where an improvement has been made by throwing it easterly upon higher ground. An inspection of the map will show that this line commences at a point on Front street in the city of Hartford, and that after passing easterly across the river and the low grounds west of East Hartford, it takes a direction northerly, coursing its way alternately along on the table land that projects at intervals from the adjoining plains and on the intervening low river meadows, until it arrives at the depot of the Western railroad in Springfield. A large proportion of the required embankment on this line must be made from the heterogeneous mass of materials composing the river meadow. This not only contains an uncertain amount of vegetable matter, but being formed from the alluvial deposites and sediment of the adjoining river, its gravity is specifically less than that of ordinary fine river sand. To ensure the requisite stability of the road-bed on this material, against the combined action of frost and the river floods, the embankments should have a width of not less than twenty feet at the graded surface, and the bed upon which the superstructure rests should be composed of fine sand or clean gravel, to the depth of two feet, and laid at least three feet above the highest known rise of the river; large spaces should also be passed over on trestle work, giving an opportunity for the water to rise without obstruction to the same height on both sides of the embankment. This line in passing around the bold bluff at the mouth of Pecowsic brook, makes an objectionable curve, and unavoidably encroaches on the Connecticut river, so as to render a heavy slope and protection wall necessary for about eight hundred feet in length. A better location for this part of the route would most probably be obtained by

throwing the line at Thompsonville so far east as to pass with a moderate curve on the table land which forms the eastern boundary of the long meadows before described. This route may be characterized, however, as being in general very direct, curves moderate and the grades remarkably easy.

3. COMBINED EAST AND WEST ROUTE.

This is one of the routes described by Prof. Twining in his able report of the preliminary surveys. Here I may perhaps be allowed to remark that I have not been able to consult with Prof. Twining, the engineer whom you selected for one of my counsellors; this is a cause of regret; his loss has, however, been compensated in part by the valuable assistance that I have received from consultations with Mr. Anderson now on the Western Railroad, and who was an engineer on your previous surveys and locations. The line under consideration, contemplates leaving Hartford at any point which its citizens may hereafter select in the northern and eastern portion of the city; it connects conveniently, though rather expensively, with the Hartford and New Haven railroad depot: a glance at the large map will show the different lines that have been surveyed and made the basis of estimates for its several terminating points. On leaving the city, the line pursues a very direct and easy northerly course until it arrives at the foot of the falls on Connecticut river.

The location to this point has been much improved by throwing the whole line farther west, and on higher ground, thus placing it nearly beyond the reach of the floods of the adjoining river. Although the soil, to a considerable extent, is argillaceous and extremely retentive of moisture, yet this whole distance constitutes a very cheap grade and preparation of road-bed. On the map a diverging line is exhibited at Windsor, passing east of the main line and through nearly the centre of Broad street; this was located there at the request of its inhabitants, and although it will cost something more than the westerly route, yet as it will do less damage to that enterprising town, I recommend that it be substituted in place of the former location. Immediately north of Windsor street, the line must of necessity cross the valley of the Farmington river; this, though short, will unavoidably make an expensive embankment. The river itself will require a bridge of four hundred feet in length, the foundation of the abutments and piers must rest on piling prepared for its reception, at least five feet below the bed of the stream; the floor timbers of the bridge to be perfectly secure from the effects of ice in times of the highest freshet must have an elevation of thirty-five feet above average low water.

Further north this line crosses Connecticut river as indicated on the foot of the falls, and unites after making an embankment of considerable magnitude, with the east line on the east bank of the river before described. This place of crossing, when examined in all of its bearings, will be found, in my judgment, more favorable for the construction and permanent security of a railroad bridge than any other which can be selected between Hartford and Springfield. The curves though smaller than upon most other parts of the line are still moderate; the embankments are necessarily heavy and unfavorably placed in relation to the general direction of the river; still their bases are so high above the ordinary floods that they may be cheaply protected. The foundation for a bridge superstructure is a consideration of the greatest importance; when your works can be founded on the solid rock, you only require good materials, suitably put together, to make your construction as durable as the rocks themselves; in a work of this magnitude, when you have not such a foundation, you must make one that shall be equal to it. There has been such a constant pass-

ing of ice during the past mild winter, that it has not been possible to make the requisite soundings, to ascertain with certainty the exact character of the river bed at this desirable crossing; from the best knowledge that I can obtain, however, from those who are well acquainted with the river at this point, I am inclined to believe that a rock foundation exists at no inconvenient depth below the bed of the stream. If so, this will doubtless be a consideration of great weight in favor of the final location of this road upon this route.

4. WEST ROUTE ON THE WEST BANK OF THE RIVER.

This line from Hartford to the foot of the falls, forms the southern half of the combined east and west route just described. Commencing the description therefore at a point one quarter of a mile west and south of Abbe's tavern, the whole "approximately located" line, extending in a northerly direction nine miles, was thrown directly west so far as to pass entirely clear of nearly the whole of the deep basins and ravines in the immediate vicinity of the falls and canal, and crossing Stoney Brook at the only point where natural rock abutments can be obtained for the necessary bridge superstructure. This line as improved, is very direct, and instead of being onerously expensive, as was the case with the old line, it has a remarkably cheap and easy grade. A part of this great improvement was suggested by Mr. Twining in his report, the remaining portion is due to the engineer upon that line. (See detailed report marked A.) Several branch lines were run in this vicinity for various objects. On the line which crosses King's Island, it was necessary to adopt a grade of forty feet to the mile, thus exceeding the maximum grade established on every other line by ten feet per mile, besides giving an increased length of bridge superstructure compared with the crossing at the foot of the falls, of two hundred feet. On the line which crosses the river at the head of the falls, it is necessary to introduce curves that are considered objectionable; in all other respects this crossing is favorable, presenting a rock foundation for the bridge superstructure. From the State line northerly, the located route coincides with that formerly surveyed. Towards its termination, it diverges and crosses the Agawam river and valley in two distinct lines. In both cases the embankments are extremely heavy, and placed, particularly on the eastern line, in a direction transverse to the general current of the Agawam river, which is extremely rapid in time of high freshets. I am of the opinion, however, all things being duly considered, that the eastern line crossing directly the Agawam and its meadows are preferable to the one farther west, and have based my estimates accordingly.

(*To be continued.*)

Boston and Lowell Railroad.—From the last annual report we learn that four miles of second track have been laid during the last year making twenty miles of this track now in use, and leaving about five miles only to be laid, which will probably be completed in the course of the ensuing summer. The amount expended in construction to the present time is $1,729,242; leaving of the capital unexpended $70,557.

The receipts of the last year amounted to $231,575, of which from passengers in cars of the Boston and Lowell Railroad 85,928; merchandise in do 80,328, mail 1,958; from the Nashua and Lowell Railroads 24,347; merchandise from do. 18,928; passengers from Boston and Portland Railroad 16,733; merchandize do. $4,358.

The expense of the year were for repairs of road $21,813; repairs of engines and cars, 12,465; other expenses 55,933; total $91,400. Two dividends have been paid during the year, of 4 per cent, each; on $1,650,000, amounting to $132,000.